APPENDIX A
ANNEX G-4

G-4: CEPP PIR Flow Easement Basin (FEB) Preliminary Seepage Analysis

Please refer to the pdf bookmarks for
direct access to each annex

ANNEX G4. CEPP PIR FLOW EASEMENT BASIN (FEB) PRELIMINARY SEEPAGE ANALYSIS

Geotechnical Seepage Analysis CEPP Flow Easement Basin (FEB)

1. General. This section is a description of the geotechnical seepage analysis performed for the Flow Equalization Basin (FEB) feature associated with the Central Everglades Protection Project (CEPP). The FEB is situated in South Florida and lies south of the Bolles Canal, north of Levee L-5, east of the Miami Canal (L-23) and west of the EAA project. It is to be bordered to the east by the STA3/4 Inflow Canal and to the South by the STA3/4 Supply Canal. The proposed FEB footprint is indicated in Figure G-1.

2. Regional Geology. The regional geologic conditions of the proposed FEB are varied in this area (see Figure G-1). Along the southern boundary near L-5, and the Miami Canal to the west, recent fill materials consisting of poorly graded gravel, sand, silt, and minor amounts of shells vary in thickness from 0.5 foot to 6 feet thick. This fill material extends to other canal areas of Broward County. Below this fill material and throughout most of the surficial cover of northern Broward County, Quaternary shelly-sediments of the Plio-Pleistocene age prevail. The shelly sediments consist of mollusk bearing sediments (sands and carbonates) (P. Schweitzer, 2010). These conditions may also be marginally applicable to the FEB site in Palm Beach County as well.

Below these sediments is the Miami Limestone (Pleistocene) which represents the upper portion of the well-known Biscayne Aquifer. Thickness of the Biscayne Aquifer varies considerably from 10 feet in the northwest end of the county to 240 feet by Ft. Lauderdale which is situated in eastern Broward County (U.S. Geological Survey, 1970); however, the Miami Limestone's maximum thickness is 40 feet toward the coast (U.S. Army of Corps of Engineers, 2011). The Miami Limestone consists of two facies (P. Schweitzer, 2010): an oolitic facies of white to orangish gray, poorly to moderately indurated, sandy, oolitic limestone with scattered concentrations of fossils and a bryozoan facies of white to orangish gray, poorly to well-indurated, sandy, fossiliferous limestone.

The Ft. Thompson Formation represents the base of the Biscayne Aquifer. It is over 200 feet thick in eastern Palm Beach County. This unit consists of alternating beds of marine, brackish and freshwater limestones. The hydraulic conductivity of this formation averages 40,000 feet per day (U.S. Army Corps of Engineers, 2011).

Groundwater within the Biscayne Aquifer is at or near the ground surface and is generally undulating conforming to the topography. The water table commonly slopes eastward toward the coast, except in the Everglades, where it slopes southward. The groundwater table normally lies within the Miami Limestone or organic soils of recent age. Water table fluctuations are heavily influenced by seasonal rainfall, natural discharge, and pumping.

3. Local Geology. The local geology of the FEB feature begins at the surface with peaty material (peaty clay and/or organic sand), generally with an average thickness of 5-8 feet. Below that are undifferentiated layers of sandy, clayey materials of marginal thickness. Below these are consolidated and unconsolidated sediments of the Ft. Thompson formation. The Ft. Thompson limestone is pitted to vuggy with quartz sand-filled voids. The thickness of the Ft. Thompson limestone in this area is indeterminable at this time due to sparse subsurface exploration data.

Underlying the Ft. Thompson formation is the Caloosahatchee Marl which consists of shelly sands and shell marls. Below this formation is the Tamiami Formation which has a maximum depth of 65 feet to the top of the formation. This is the base of the unconfined water-table aquifer (Schroeder et al, 1954). Within the FEB, the majority of the surficial soils are Histosols which includes Everglades peats and Loxahatchee peats (Gleason et al., 1974; Bruland, 2006). According to Gleason et al, 1974, Everglades peats develop on topographic high areas and are comprised of *Cladium* tissue. Everglades peats are typically brown to black with minimal mineral content. Loxahatchee peats are found in topographic low areas and are composed of the remains of the roots and rhizomes of *Nymphea*, a white water lily. Loxahatchee peats have been classified as the Terra Ceia series (Euic, hyperthermic Typic Haplosaprists) (Soil Conservation Service, 1978). The western margin of WCA-3A is mixed marl peats that are derived from the underlying limestone (Brown et al., 1991).

4. Seismicity. South Florida is considered to be one of the most seismically stable locations in the United States (Petersen, Mark D. et. al, 2008). Historically, only minor shocks have occurred, with only one that resulted in damage. Additional shocks of suspect origin have been recorded that were felt in the Everglades area. The three Florida shocks of doubtful seismic origin rumbled through the Everglades, La Belle/Fort Myers area in July 1930, Tampa in December 1940, and the Miami/Everglades/Fort Myers area in January 1942. Most authorities attributed these incidents to blasting, but a few contend that they were seismic.

ER 1110-2-1806, (1995) indicates that South Florida is in Seismic Zone 0 (areas with least potential for seismic activity). Since no capable faults or recent earthquake epicenters are known to exist near the project site, the possibility of accelerations at the site approaching that required to induce liquefaction of the subsurface is remote. However, since this is a planned permanent impoundment and the underlying soils contain loose sand and silt granular material, a liquefaction screening evaluation will be conducted in accordance with CERP Design Criteria Memorandum No. 6. This screening will be conducted once the geotechnical investigations are completed.

5. Existing Project Data. There is only a sparse amount of subsurface geotechnical data available for the FEB. Existing subsurface used to develop the eastern dike seepage analysis cross section was taken from the EAA Reservoir A-1 Geotechnical Data Report of March 2006. A core boring and recharge test was also taken within the reservoir area with the core boring log CP02-EAARS-CB-0002 presented in Appendix G-1. This information was obtained from Report No. 02-042, Ardaman and Associates, 2003. To evaluate the seepage on the west side of the FEB, C & SF Part I Agricultural and Conservation Areas, Supplement 1 – Geology and Soils, December, 1951 provided geologic cross sections that provide subsurface information for the north and west sides of the proposed FEB impoundment. The western boundary subsurface profile can be approximately defined by Figure G-2 along L-23 from sta. 0+00 to sta. 600+00. The northern subsurface boundary of the FEB can be approximated by the cross sections taken along L -22 shown on Figures G-3 and G-4 from sta. 532+18 to sta. 0+00.

6. Seepage Model. The seepage analysis was performed on two sections of the proposed perimeter levee and canal system. The models consist of one typical section for the east dike and one of the west dike. A copy of the idealized geometry and water surface elevations used in the seepage analysis are shown on Figures G-5 and G-6. The computational tool used to model the seepage for the east and west cross sections was the two dimensional finite element program SEEP/W. The east and west SEEP/W representations of the input model are shown on Figures G-7 and G-8. Layers and hydraulic input parameters used in the SEEP/W cross sections are provided in Tables G-1 and G-2. The impoundment water level was kept at el. 10.0 ft with tailwater at the dike toe at elevation 6.0 ft.

The subsurface characterization for the model was conducted using an idealized geologic profile utilized for the EAA project immediately east of the project feature site. Due to the extremely limited geotechnical exploration data in the area of the FEB footprint, the modeled results presented provide only a tentative estimate of seepage quantities. The western cross section model was based on a recharge test at location RT-2 near core boring CP02-EAARS-CB-0002. This boring, which is located in the middle of the proposed reservoir, was performed in the 2003 geotechnical exploration program for the EAA and as described by Report No. 02-042, Ardaman and Associates, 2003. Other subsurface information used for development of the west section model was the C & SF Part I Agricultural and Conservation Areas, Supplement 1 – Geology and Soils, December, 1951 and C & SF Part I Agricultural and Conservation Areas, Supplement 7 – Permeability Investigations by Well Pumping Tests, February, 1953, and Report of Investigations No. 13 (RI-13), Water Resources of Palm Beach County, Florida, 1954.

Table G-1. Eastern Seepage Model Cross Section Material Properties

Layer	Elevation Extent (feet)	Kx, Horizontal Hydraulic Conductivity (fpd)	Anisotropy Ratio, Ky/Kx
Dike Sand	EL. 15.0->EL. 6.0	3.0	1.0
Caprock Limestone	EL. 6.0->EL.3.0	100	0.1
Upper Okeechobee-Upper Limestone	EL. 3.0-> -13.0	60	0.42
Upper Okeechobee-Lower Limestone	EL. -13.0 ->-24.0	200	0.375
Lower Okeechobee-Upper Sands	EL. -24.0 ->-56.2	250	0.5
Tamiami Formation	EL. -56.20 ->-89.9	36	0.5

Table G-2. Western Seepage Model Cross Section Material Properties

Layer	Elevation Extent (feet)	Kx, Horizontal Hydraulic Conductivity (fpd)	Anisotropy Ratio, Ky/Kx
Dike Sand	EL. 15.0->EL. 6.0	3.0	1.0
Caprock Limestone	EL. 6.0->EL.3.0	283	0.1
Upper Okeechobee-Upper Limestone	EL. 3.0-> -13.0	72	0.42
Upper Okeechobee-Lower Limestone	EL. -13.0 ->-24.0	200	0.375
Lower Okeechobee-Upper Sands	EL. -24.0 ->-56.2	250	0.5
Tamiami Formation	EL. -56.20 ->-89.9	36	0.5

The regional hydrogeologic features of the project feature area show the surficial aquifer of sand, shell and limestone tends to thicken from the western boundary at Hendry County to the eastern edge of Palm Beach County. However, from north to south, the surficial aquifer top limestone beds thicken somewhat from Lake Okeechobee to about five miles south where they become more uniform in thickness. Supplement 1 (1951) indicates the presence of cavities in the top layers of the limestone in selected borings from 1-3 feet in thickness. These, however, do not seem to be continuous, at least along the line of borings. These features may have a profound effect on the hydraulic conductivity of the subsurface strata on the west side of the reservoir. To compensate for this, the hydraulic conductivities for the east section model were increased by 20% to account for a roughly 5.2% increase in porosity over the strata matrix hydraulic conductivity values. The caprock permeability in the west section model was increased from 100 ft/day to 283 ft/day based on results of the recharge test of Report No. 02-042 (2003).

The resulting seepage quantity for the east section was 320 cubic feet/day/ft of levee, and for the west section the seepage quantity was 387 cubic feet/day/ft of levee.

7. Future Geotechnical Investigations. The seepage quantities presented for the FEB are tentative estimates. As they are a basis for the project estimate, the subsurface materials need to be characterized by a geotechnical exploration and laboratory testing program. There is a very real possibility that previous core borings did not pick up key flow channels within the underlying limerock layers and these could be so conducive to flow that they will control the seepage losses for the reservoir. In addition, laminar flow assumptions used in the Darcy's Law based models may not be applicable in some areas. Scaled test sections at the adjacent EAA project show that maintaining an operating reservoir head level over an extended period of time may be difficult without seepage control systems such as cutoff walls or reservoir bottom treatment. Furthermore, there is a potential for piping of embankment material if there are cavities and natural pipes in the levee foundation. A comprehensive geotechnical exploration program featuring components such as reservoir foundation clearing and mapping along with geophysical testing, full-scale pump testing

along with design stage core boring exploration and geotechnical laboratory testing will be required. It is recommended to begin planning for such investigations as expeditiously as possible.

8. Borrow Materials. Sands from the proposed existing borrow from the exterior canal can be used as dike fill material. Whether they can be used without processing of limestone rock fragments is to be determined. With removal of organic surficial soils, dike foundation bearing and tolerable settlement levels are anticipated.

REFERENCES

Ardaman and Associates, 2003. Report No. 02-042, Revised Conceptual Report of Geotechnical Exploration for CERP Everglades Agricultural Area Reservoirs, Phase 1, Effort 1, Task Order 1, U.S. Army Engineer District Jacksonville.

Black and Veatch, 2006, EAA Reservoir A-1 Preliminary Design Report, South Florida Water management District, West Palm, Florida.

Brown, R.B. et al., 1991, Soils *In* Myers, R.L. and Ewl, J.J. (ed.) Ecosystems of Florida: University of Central Florida Press, Orlando, FL.

Bruland, G.L. et al, 2006, Spatial Distribution of Soil Properties in Water Conservation Area 3 of the Everglades: Journal of Soil Science Society of America, v. 70, pp. 1662-1676.

_____1951, C & SF Part I Agricultural and Conservation Areas, Supplement 1 – Geology and Soils, U.S. Army Engineer District Jacksonville.

_____1953, C & SF Part I Agricultural and Conservation Areas, Supplement 7 – Permeability Investigations by Well Pumping Tests, U.S. Army Engineer District Jacksonville.

Leech, S, Harris, C., Arnold, T. Burns, A., 2005, Geotechnical Seismic Evaluation of CERP Dam Foundations, CERP Design Criteria Memorandum No. 6, U.S. Army Engineer District Jacksonville and the South Florida Water Management District.

_____, ER 1110-2-1806, 1995, Earthquake Design and Evaluation for Civil Works Projects, Department of the Army, Washington, D.C..

Gleason, P.J. et al, 1974, The environmental significance of Holocene sediments from the Everglades and saline tidal plains, p. 297-351 *In* Gleason, P.J. (ed.) Environments of South Florida, present, and past: Miami Geological Society, Coral Gables, FL.

Nodarse and Associates, 2000, Stormwater Treatment Area No. 3 and 4 East WCA-3A Hydropattern Restoration L-5 Canal, Boring Profiles.

Petersen, Mark D., et al, 2008, Documentation for the 2008 Update of the United States National Seismic Hazard Maps: U.S. Geological Survey Open-File Report 2008–1128, 61 p.

Schroeder, M., Milliken, D., and Love, S., 1954, Water Resources of Palm Beach County, Florida – Report of Investigations No. 13, Florida Geological Survey, Tallahassee, FL.

Schweitzer, P., 2010, Mineral Resources On-Line Spatial Data, Geologic Units in Broward County, Florida: U.S. Geological Survey, 2 pp.

Soil Conversation Service, 1978, Soil Survey of Palm Beach County area of Florida: U.S. Government Printing Office, Washington D.C.

U.S. Army Corps of Engineers, 1954, Central and Southern Florida Project, Supplement 21 Design Memorandum Agricultural Area Levees L-4, L-5, and L-6, 72 pp.

U.S. Army Corps of Engineers, 2011, Central and Southern Florida Project, CERP, Biscayne Bay Coastal Wetlands Project Phase I, Final Integrated Project Implementation Report and Environmental Impact Statement, 512 pp.

U.S. Geological Survey, 1970, Groundwater Atlas of the United States, Alabama, Florida, Georgia, and South Carolina HA730-G.

Figure G-1. Aerial Photograph of Project Site

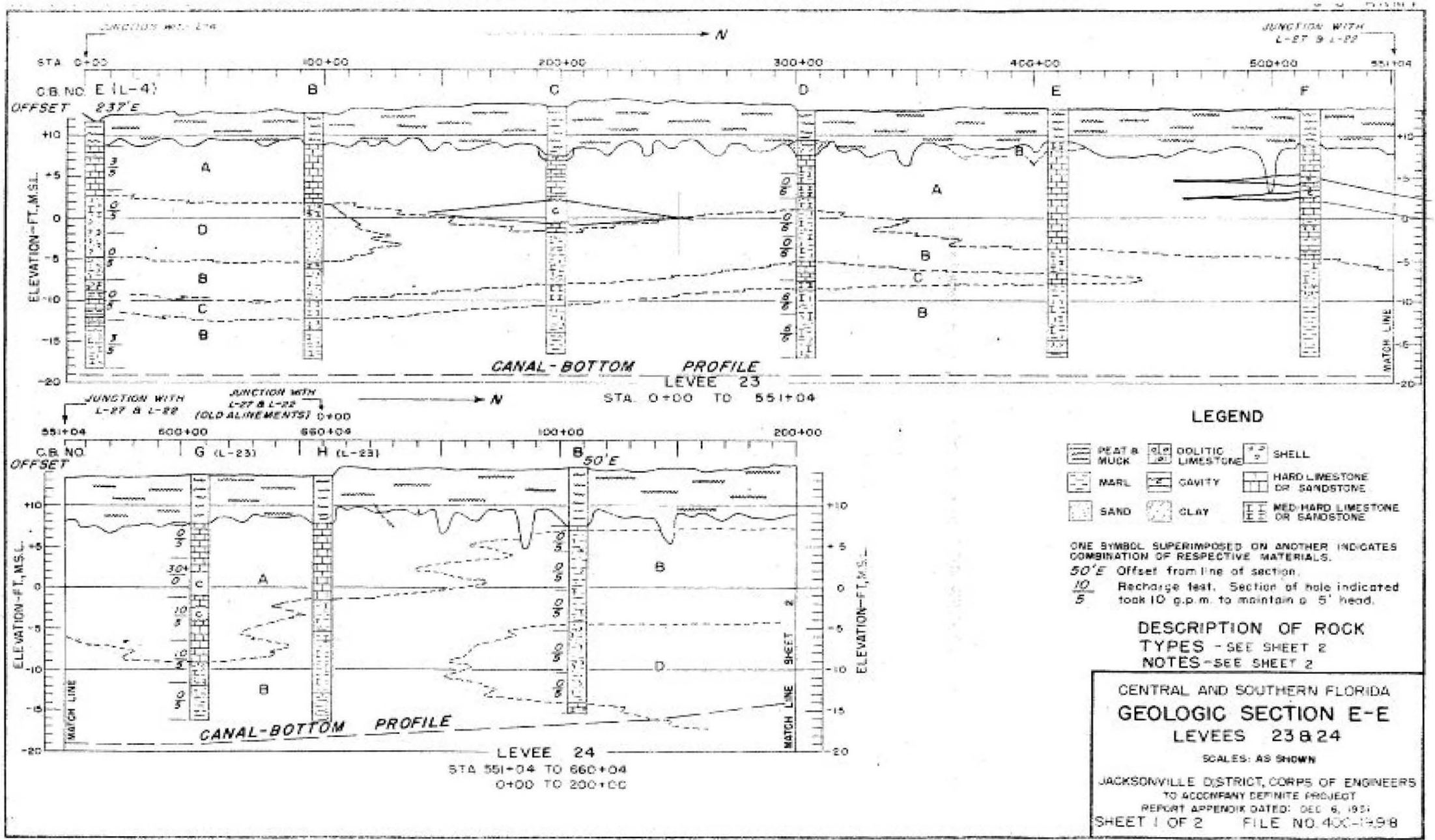
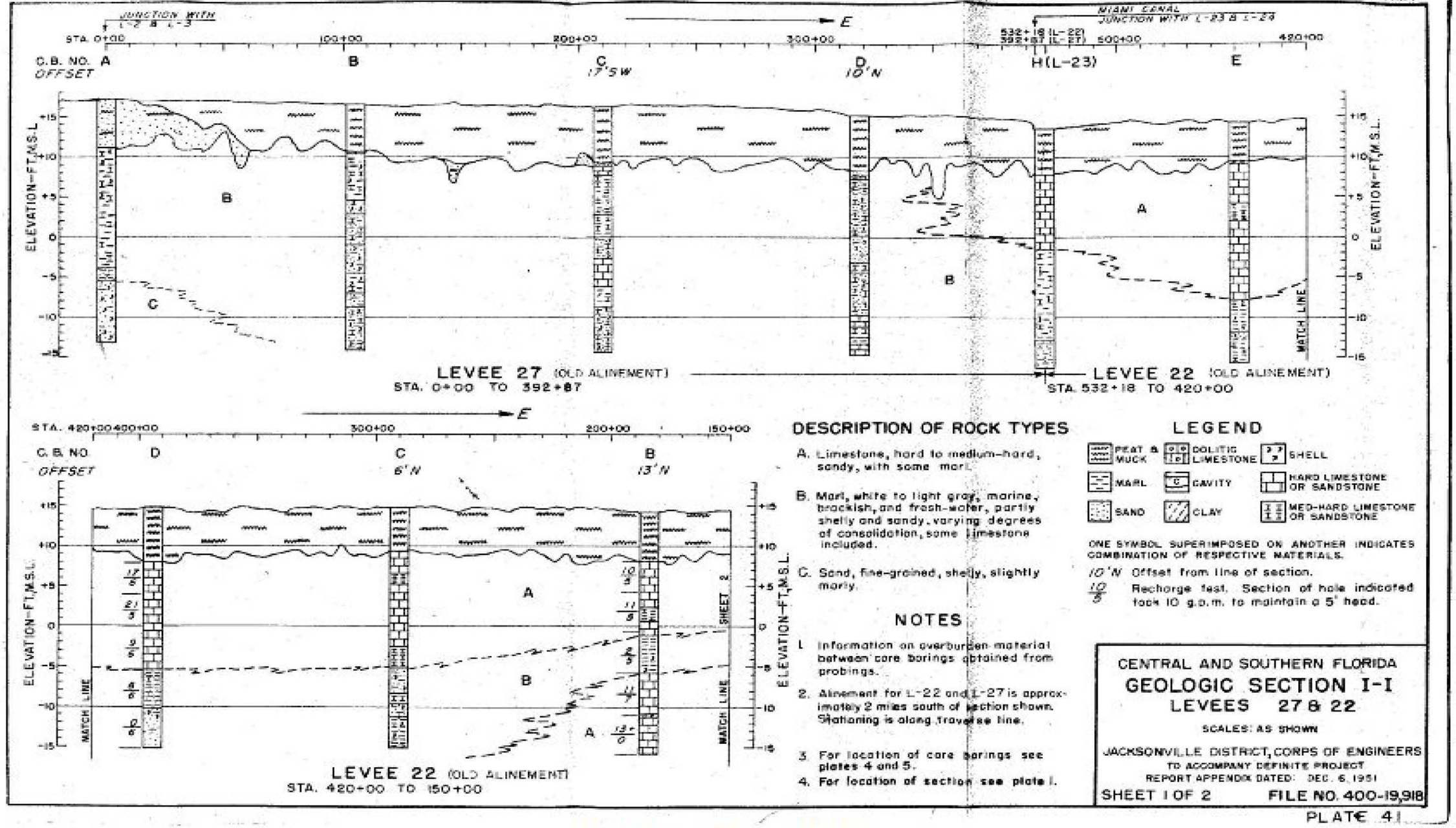


Figure G-2. Geologic Section L-23 & L-24



DESCRIPTION OF ROCK TYPES

A. Limestone, hard to medium-hard, sandy, with some marl.

B. Marl, white to light gray, marine, brackish, and fresh-water, partly shelly and sandy, varying degrees of consolidation, some limestone included.

C. Sand, fine-grained, shelly, slightly marly.

NOTES

1. Information on overburden material between core borings obtained from probings.
2. Alinement for L-22 and L-27 is approximately 2 miles south of section shown. Stationing is along traverse line.
3. For location of core borings see plates 4 and 5.
4. For location of section see plate 1.

LEGEND

PEAT & MUCK · OOLITIC LIMESTONE · SHELL
MARL · CAVITY · HARD LIMESTONE OR SANDSTONE
SAND · CLAY · MED-HARD LIMESTONE OR SANDSTONE

ONE SYMBOL SUPERIMPOSED ON ANOTHER INDICATES COMBINATION OF RESPECTIVE MATERIALS.

10'N Offset from line of section.

10/5 Recharge test. Section of hole indicated took 10 g.p.m. to maintain a 5' head.

CENTRAL AND SOUTHERN FLORIDA

GEOLOGIC SECTION I-I

LEVEES 27 & 22

SCALES: AS SHOWN

JACKSONVILLE DISTRICT, CORPS OF ENGINEERS
TO ACCOMPANY DEFINITE PROJECT
REPORT APPENDIX DATED: DEC. 6, 1951

SHEET 1 OF 2 FILE NO. 400-19,918

PLATE 41

Figure G-3. Geologic Section L-27 & L-22

CORPS OF ENGINEERS U. S. ARMY

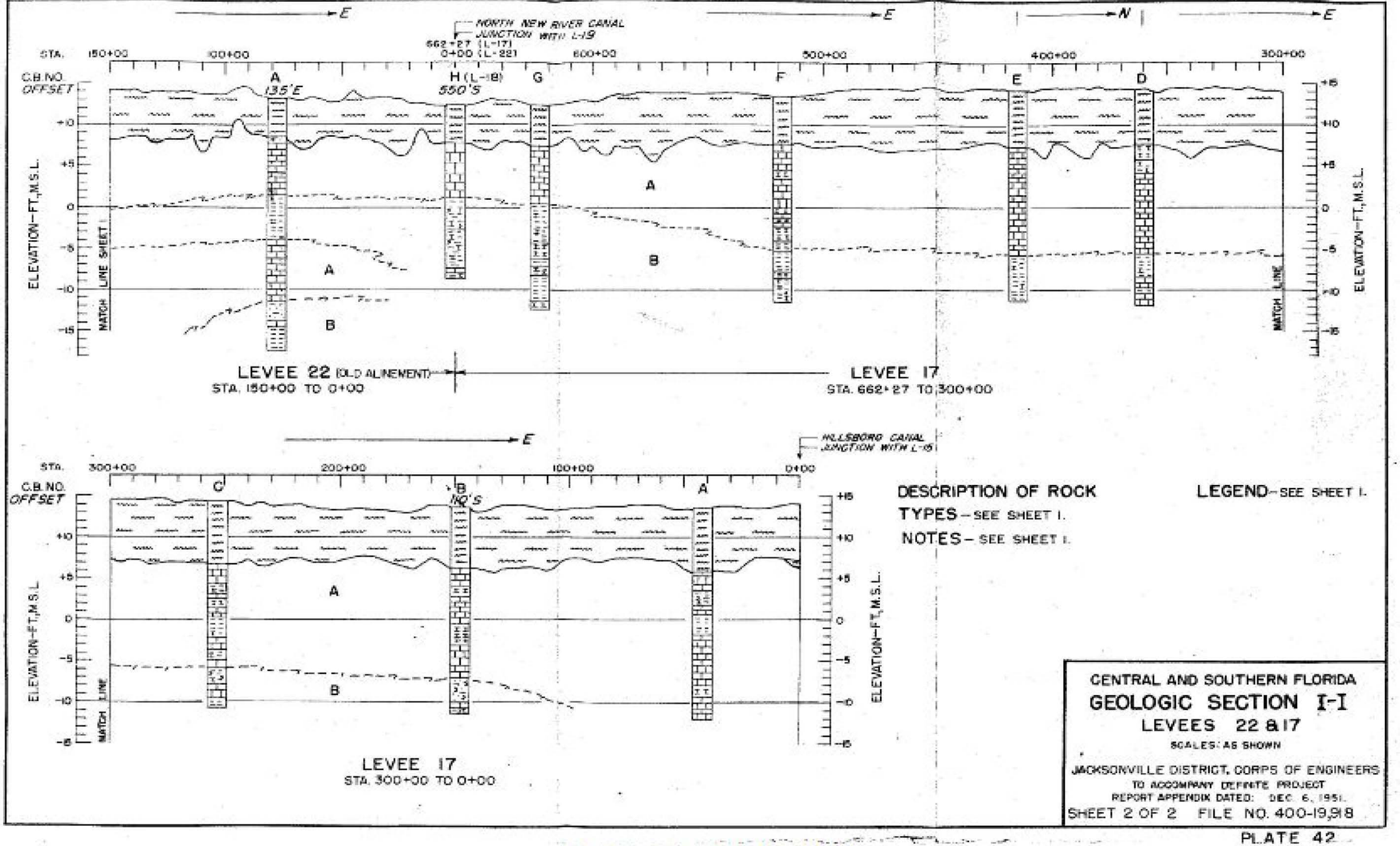


Figure G-4. Geologic Section L-22 & L-17

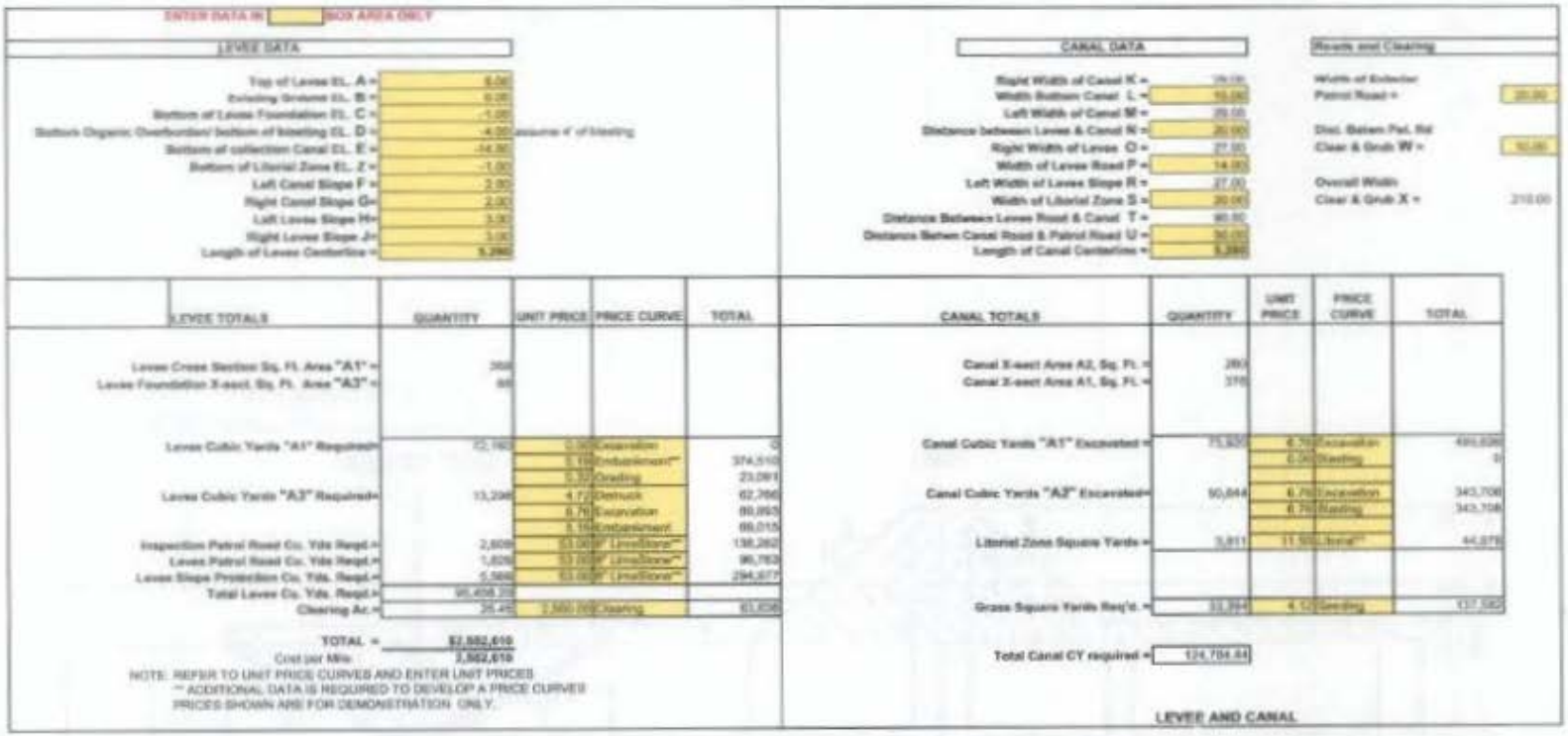


Figure G-5. FEB Seepage Model Input Data

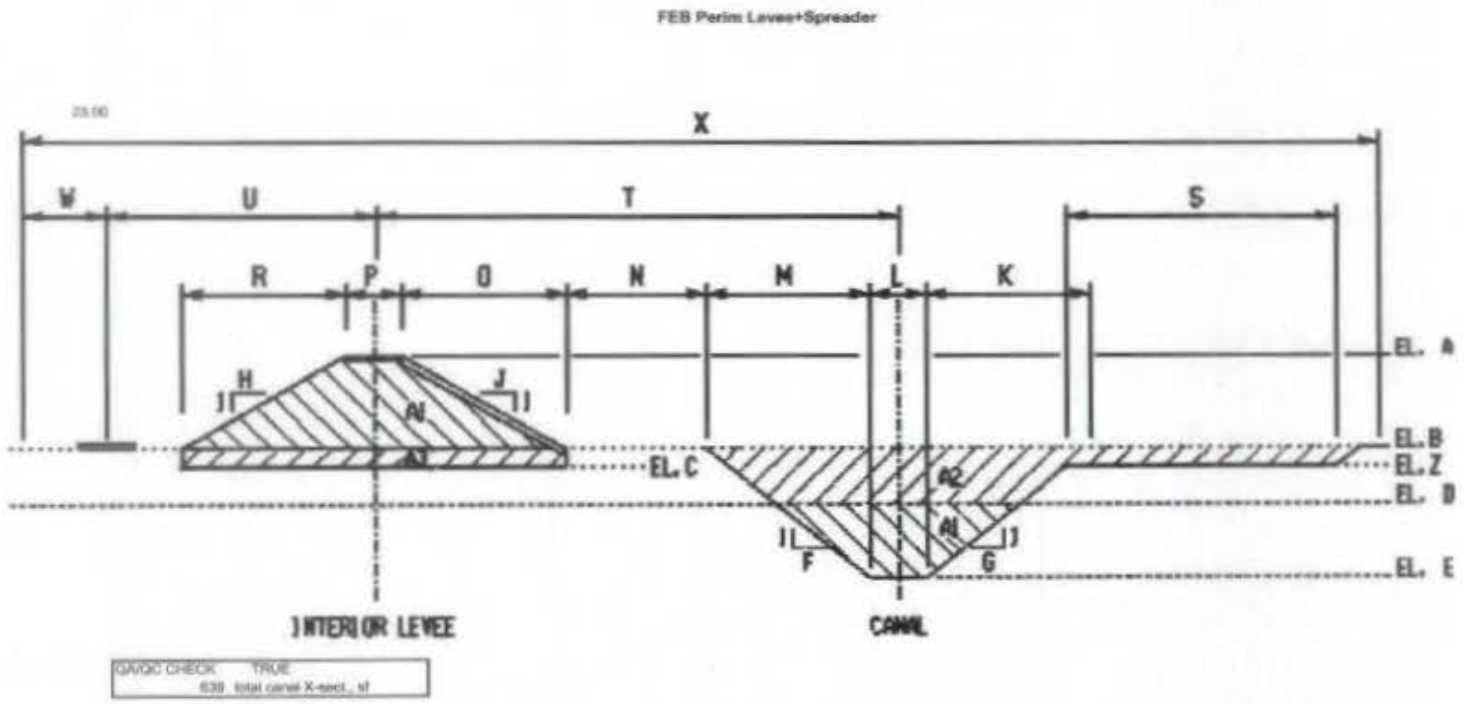


Figure G-6. FEB Seepage Model Idealized Cross Section Geometry

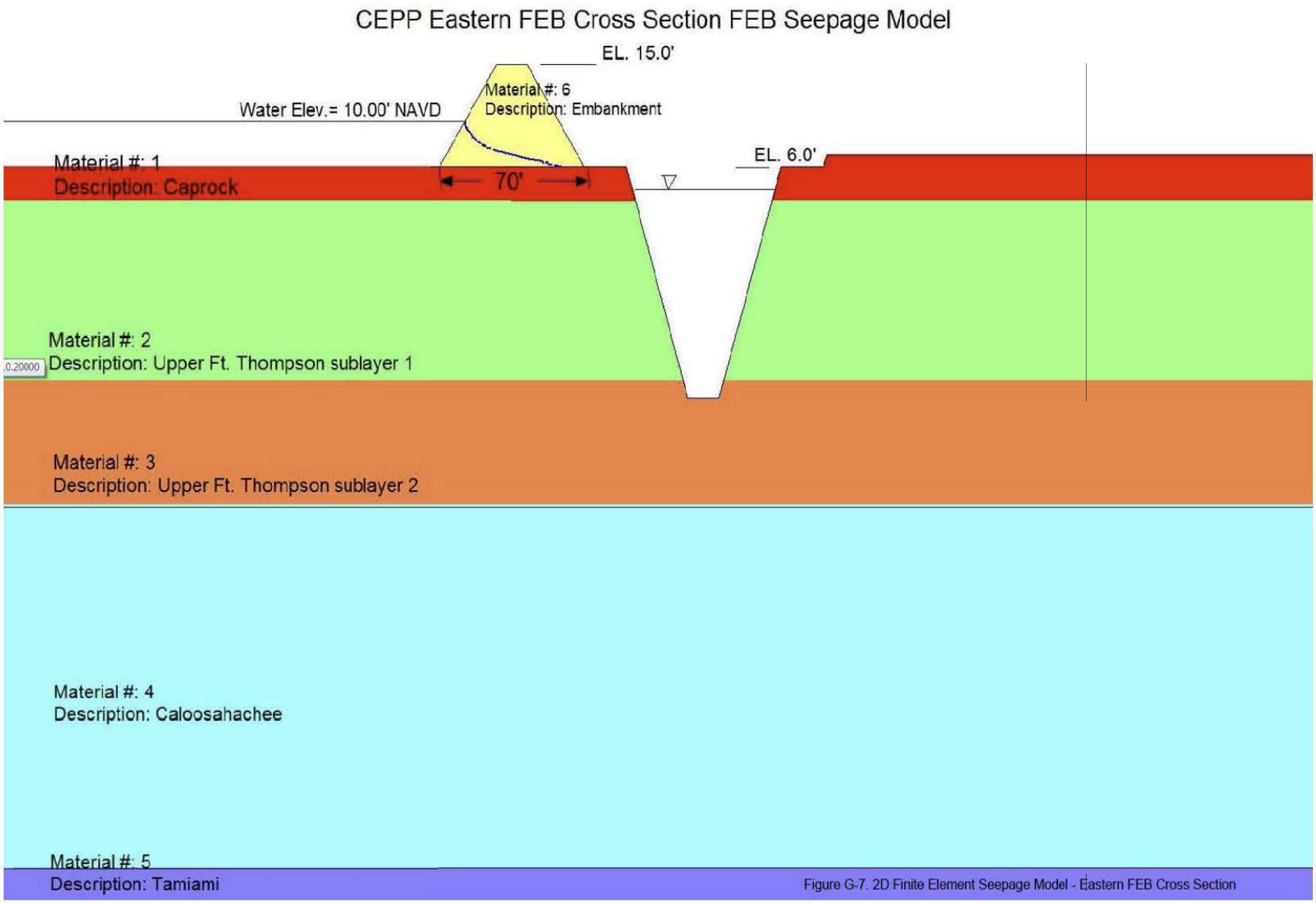


Figure G-7. 2D Finite Element Seepage Model - Eastern FEB Cross Section

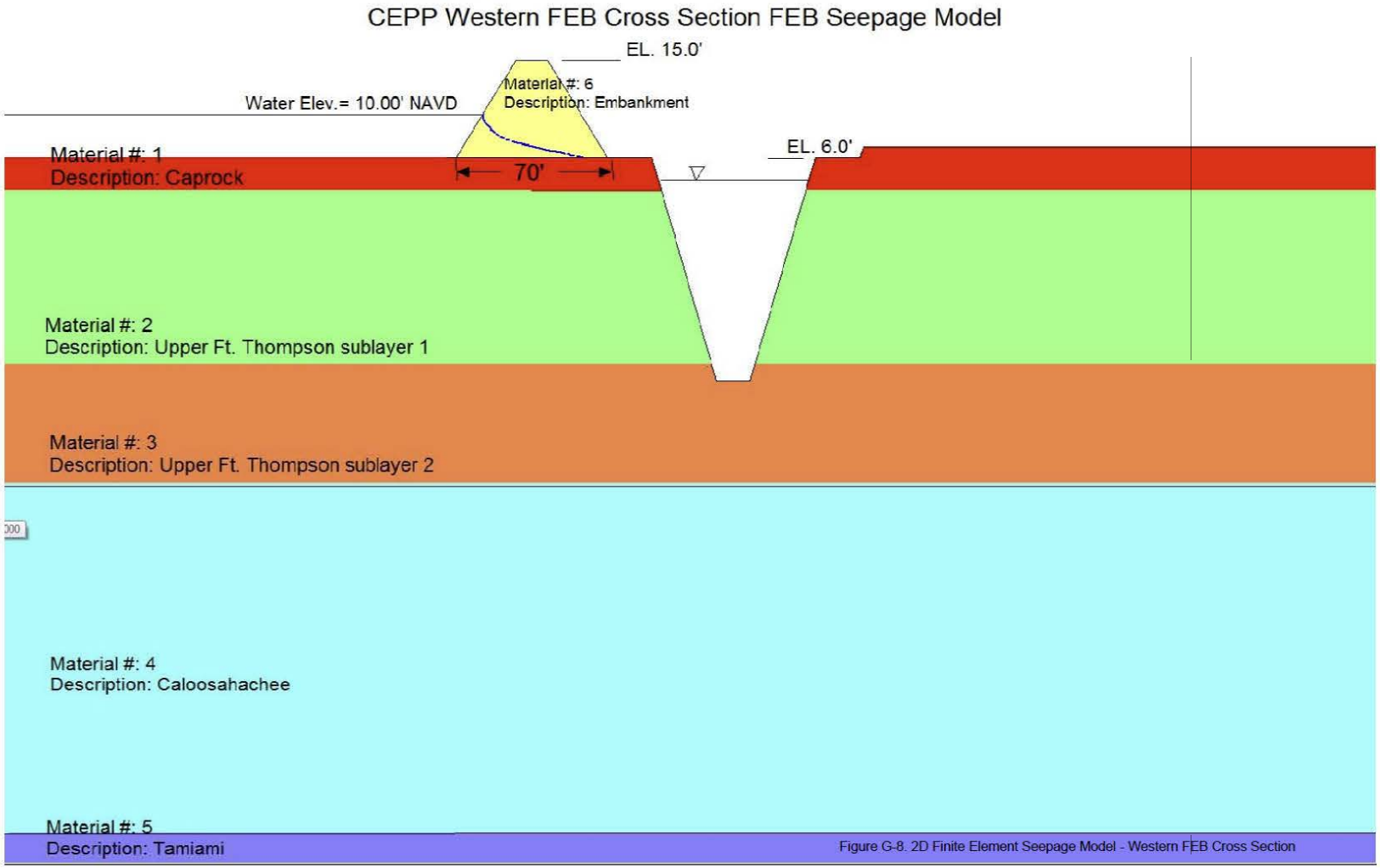


Figure G-8. 2D Finite Element Seepage Model - Western FEB Cross Section

APPENDIX G

CORE BORING

CP02-EAARS-CB-0002

Boring Designation CP02-EAARS-CB-0002

DRILLING LOG

DIVISION: South Atlantic		INSTALLATION: Jacksonville District	SHEET 1 OF 10 SHEETS
1. PROJECT: CERP Everglades Agricultural Area Reservoirs Phase 1, Effort 1, Compartment A		9. SIZE AND TYPE OF BIT: See Remarks	
		10. COORDINATE SYSTEM/DATUM: State Plane, FLE	HORIZONTAL: NAD83 / VERTICAL: NAVD88
2. BORING DESIGNATION: CP02-EAARS-CB-0002	LOCATION COORDINATES: X = 736,775 Y = 775,528	11. MANUFACTURER'S DESIGNATION OF DRILL: CME-55	☐ AUTO HAMMER ☒ MANUAL HAMMER
3. DRILLING AGENCY: Ardaman & Associates, Inc.	CONTRACTOR FILE NO.: 02-042	12. TOTAL SAMPLES: DISTURBED 118	UNDISTURBED (UD): 0
4. NAME OF DRILLER: M. Gulick		13. TOTAL NUMBER CORE BOXES: 5	
5. DIRECTION OF BORING: ☒ VERTICAL ☐ INCLINED	DEG. FROM VERTICAL:	BEARING:	14. ELEVATION GROUND WATER: Not Determined
		15. DATE BORING: STARTED 08-13-02	COMPLETED 09-03-02
6. THICKNESS OF OVERBURDEN: 5.4 Ft.		16. ELEVATION TOP OF BORING: 12.0 Ft.	
7. DEPTH DRILLED INTO ROCK: 13.5 Ft.		17. TOTAL RECOVERY FOR BORING: 80 %	
8. TOTAL DEPTH OF BORING: 180.0 Ft.		18. SIGNATURE AND TITLE OF INSPECTOR: H. Snyder, Civil Engineer	

ELEV.	DEPTH	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR COREDR	REMARKS	BLOWS/0.5 FT.	N-VALUE
12.0	0.0					12.0		
		FILL, gravelly, mixture of fine gravel size limestone, fine to coarse grained limestone sand, and silt, dry, light gray	13	1		SPT Sampler	32 / 32 / 8	40
						10.4		
			40	2		SPT Sampler	4 / 6 / 6	12
9.0	3.0					9.0		
8.8	3.2	SAND, silty, mostly fine-grained , some silt, dry, dark brown (SM)						
		Limestone, hard, slightly weathered, medium-grained, porous to pitted, light gray-green	47	3		SPT Sampler	1 / 2 / 4	6
						7.4		
			100	4		SPT Sampler	16 / 50/0.4'	
						6.6		
5.0	7.0	Limestone, moderately hard	50	6 BOX 1	RQD 28	4 x 5-1/2" Diamond Impregnated Bit DT = 80 mins HP = 100 psi		
						2.0		
			100	7	RQD 0	4 x 5-1/2" Diamond Impregnated Bit 9 mins, 100 psi		
						0.9		
			80	8		SPT Sampler	4 / 4 / 29	33
						-0.6		
			50	9		-1.0 SPT Sampler	50/0.4'	
			45	BOX 2	RQD 39	4 x 5-1/2" Diamond Impregnated Bit DT = 23 mins HP = 100 psi		

Slightly Weathered

0 5 10 15

(Continued)

SAJ FORM 1836
JUN 02

G-1

Boring Designation CP02-EAARS-CB-0002

DRILLING LOG (Cont. Sheet)	INSTALLATION: Jacksonville District	SHEET 2 OF 10 SHEETS
PROJECT: CERP Everglades Agricultural Area Reservoirs	COORDINATE SYSTEM/DATUM: State Plane, FLE / HORIZONTAL: NAD83 / VERTICAL: NAVD88	
LOCATION COORDINATES: X = 736,775 Y = 775,528	ELEVATION TOP OF BORING: 12.0 Ft.	

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	RQD OR CR	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
			At El. -3.0 Ft., vuggy	45	BOX	RQD 39	4 x 5-1/2" Diamond Impregnated Bit		
-4.0	16.0						DT = 23 mins		
			Limestone, hard, unweathered, fine-grained, vuggy, trace of shell, gray	NR	11		HP = 100 psi	50/0.2'	
							-4.2 SPT Sampler		
				84	BOX	RQD 50	4 x 5-1/2" Diamond Impregnated Bit DT = 15 mins HP = 100 psi		
							-8.0		
				70	BOX	RQD 40	4 x 5-1/2" Diamond Impregnated Bit 8 mins, 100 psi		
							-9.0		
			At El. -9.0 Ft., little shell	33	14		SPT Sampler	6, 7, 8	15
							-10.6		
			At El. -10.6 Ft., trace silt	47	15		SPT Sampler	7, 9, 10	19
-12.0	24.0						-12.0		
			SAND, poorly-graded with silt, some angular fine-grained quartz, some fine-grained limestone, little angular shell, trace phosphate, light brown (SP-SM)	47	16		SPT Sampler	7, 10, 11	21
							-13.6		
				47	17		SPT Sampler	11, 10, 11	21
-15.0	27.0						-15.0		
			SAND, silty, mostly fine-grained quartz, trace angular fine-grained shell, trace clay, trace phosphate, light gray (SM)	73	18		SPT Sampler	8, 9, 9	18
							-16.6		
			At El. -17.0 Ft., little clay	87	19		SPT Sampler	7, 6, 6	12
							-18.0		
				87	20		SPT Sampler	8, 5, 5	10
-19.6	31.5						-19.6		
			SAND, poorly-graded with silt, mostly fine-grained quartz, little shell, few silt, light brown (SP-SM)	73	21		SPT Sampler	8, 8, 12	20
							-21.0		
				73	22		SPT Sampler	10, 11, 13	24
-22.6	34.5						-22.6		
			SAND, poorly-graded, mostly fine to	75	23		SPT Sampler	11	

SAJ FORM 1836-A
JUN 02

(Continued)

G-2

Boring Designation CP02-EAARS-CB-0002

DRILLING LOG (Cont. Sheet)	INSTALLATION	SHEET 3 OF 10 SHEETS
	Jacksonville District	

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
CERP Everglades Agricultural Area Reservoirs	State Plane, FLE	NAD83	NAVD88

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 736,775 Y = 775,528	12.0 Ft

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	REC.	BOX OR SAMPLE NO.	CORE RUN	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
			medium-grained quartz, some angular fine to medium-grained shell, few phosphate, trace silt, light brown to light gray (SP)	75	23		SPT Sampler	11 11	22
			At El. -24.0 Ft., trace shell, trace of shell				-24.0		
				93	24		SPT Sampler	6 7 8	15
							-25.6		
				87	25		SPT Sampler	3 5 5	10
							-27.0		
				67	26		SPT Sampler	4 6 7	13
							-28.6		
				73	27		SPT Sampler	5 5 7	12
			At El. -30.0 Ft., trace fine gravel-sized shell				-30.0		
				60	28		SPT Sampler	5 6 7	13
							-31.6		
				93	29		SPT Sampler	7 4 7	11
							-33.0		
				80	30		SPT Sampler	10 8 8	16
			At El. -34.6 Ft., trace fine gravel-sized limestone				-34.6		
				93	31		SPT Sampler	10 8 11	19
-36.6	48.5						-36.0		
			Limestone, hard, fine-grained, trace of silt, few fine grained sand, trace of clay, gray	93	32		SPT Sampler	9 29 34	63
							-37.6		
				53	33		SPT Sampler	14 6 9	15
-39.0	51.0						-39.0		
			SAND, poorly-graded, mostly fine-grained shell, trace coarse gravel-sized phosphate, trace clay, gray (SP)	80	34		SPT Sampler	4 5 6	11
							-40.6		
			From El. -40.6 to -45.0 Ft., mostly medium to coarse-grained shell, trace fine gravel-sized shell, trace clay, light brown	73	35		SPT Sampler	11 19 26	45
							-42.0		
				87	36		SPT Sampler	17 20	

SAJ FORM 1836-A
JUN 02

(Continued)

G-3

Boring Designation CP02-EAARS-CB-0002

DRILLING LOG (Cont. Sheet)	INSTALLATION: Jacksonville District	SHEET 4 OF 10 SHEETS
PROJECT: CERP Everglades Agricultural Area Reservoirs	COORDINATE SYSTEM/DATUM: State Plane, FLE / HORIZONTAL: NAD83 / VERTICAL: NAVD88	
LOCATION COORDINATES: X = 736,775 Y = 775,528	ELEVATION TOP OF BORING: 12.0 Ft.	

ELEV.	DEPTH	CLASSIFICATION OF MATERIALS	REC.%	BOX OR EXAMPLE	ROD OR CORE	REMARKS	BLOWS/6 IN.	N-VALUE
			87	36		-43.6 SPT Sampler	19	39
			87	37		SPT Sampler	15 19 22	41
-45.0	57.0					-45.0		
		SAND, poorly-graded with clay, mostly medium-grained sand, little clay, little angular shell, trace fine gravel-sized shell, gray (SP-SC)	100	38		SPT Sampler	12 16 13	29
		At El. -47.0 Ft., few shell, trace clay	60	39		-46.6 SPT Sampler	14 17 19	36
			93	40		-48.0 SPT Sampler	10 14 14	28
-49.6	61.5					-49.6		
		SAND, clayey, mostly fine to medium-grained sand, some clay, little fine gravel-sized shell, gray (SC)	87	41		SPT Sampler	10 19 31	50
			93	42		-51.0 SPT Sampler	10 13 12	25
		At El. -52.6 Ft., some shell, trace clay, lens of clay	73	43		-52.6 SPT Sampler	13 13 20	33
			100	44		-54.0 SPT Sampler	10 11 11	22
-55.6	67.5					-55.6		
		SAND, poorly-graded with clay, mostly shell (SP-SC)	67	45		SPT Sampler	10 12 16	28
			93	46		-57.0 SPT Sampler	15 14 12	26
			53	47		-58.6 SPT Sampler	11 12 16	28
			67	48		-60.0 SPT Sampler	18 14 19	33
		At El. -61.6 Ft., mostly shell	87	49		-61.6 SPT Sampler	6 12 15	27
						-63.0		

(Continued)

SAJ FORM 1836-A
JUN 02

G-4

Boring Designation CP02-EAARS-CB-0002

DRILLING LOG (Cont. Sheet)

INSTALLATION	SHEET 6 OF 10 SHEETS
Jacksonville District	

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
CERP Everglades Agricultural Area Reservoirs	State Plane, FLE	NAD83	NAVD88

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 736,775 Y = 775,528	12.0 Ft.

ELEV.	DEPTH	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE	ROD OR CORE	REMARKS	BLOWS/0.5 FT.	N-VALUE
-63.8	75.7	Limestone, fine-grained, trace of clay, trace of phosphate, gray	93	50		SPT Sampler	20 18 18	36
						-64.6		
			53	51		SPT Sampler	14 16 17	33
-66.0	78.0					-66.0		
		SAND, poorly-graded, mostly fine to medium-grained quartz, trace sandstone, trace shell, light gray (SP)	67	52		SPT Sampler	10 40 45	85
						-67.6		
			67	53		SPT Sampler	26 32 49	81
						-69.0		
			100	54		SPT Sampler	36 65 57	122
						-70.6		
			87	55		SPT Sampler	10 14 20	34
						-72.0		
			93	56		SPT Sampler	14 28 29	57
						-73.6		
			53	57		SPT Sampler	14 17	
						-75.0		
			87	59		SPT Sampler	8 18 29	47
						-76.6		
			87	60		SPT Sampler	24 34 42	76
						-78.0		
			73	61		SPT Sampler	9 18 20	38
						-79.6		
		From El. -79.6 to -80.6 Ft., mostly coarse-grained quartz, trace phosphate, trace shell, trace sandstone, light gray	93	62		SPT Sampler	4 10 6	16
-80.6	92.5					-81.0		
		SAND, clayey, mostly medium to coarse-grained sand, some clay, trace phosphate, trace shell, gray (SC)	100	63		SPT Sampler	5 7 12	19
		At El. -82.0 Ft., trace sand				-82.6		
		At El. -82.6 Ft., little shell, little limestone	100	64		SPT Sampler	3	

(Continued)

SAJ FORM 1836-A
JUN 02

G-5

Boring Designation CP02-EAARS-CB-0002

DRILLING LOG (Cont. Sheet)	INSTALLATION: Jacksonville District	SHEET 6 OF 10 SHEETS
PROJECT: CERP Everglades Agricultural Area Reservoirs	COORDINATE SYSTEM/DATUM: State Plane, FLE / HORIZONTAL: NAD83 / VERTICAL: NAVD88	
LOCATION COORDINATES: X = 736,775 Y = 775,528	ELEVATION TOP OF BORING: 12.0 Ft.	

ELEV.	DEPTH	CLASSIFICATION OF MATERIALS	REC.	BOX OR SAMPLE	ROD OR CORE	REMARKS	BLOWS/0.5 FT.	N VALUE
			100	64		SPT Sampler	9 / 7	16
		At El. -84.0 Ft., trace sand				-84.0		
			100	65		SPT Sampler	10 / 8 / 9	17
						-85.6		
		At El. -86.0 Ft., trace limestone	87	66		SPT Sampler	18 / 21 / 26	47
		At El. -87.0 Ft., some shell				-87.0		
			67	67		SPT Sampler	12 / 22 / 29	51
-88.6	100.5					-88.6		
		SAND, clayey, mostly fine to coarse-grained sand, some clay, few shell, trace phosphate, gray (SC)	100	68		SPT Sampler	14 / 9 / 14	23
-90.0	102.0					-90.0		
		Sandstone, fine-grained, few shell, trace of clay, trace of phosphate, gray	67	69		SPT Sampler	5 / 16 / 20	36
						-91.6		
			100	70		SPT Sampler	17 / 16 / 17	33
						-93.0		
			87	71		SPT Sampler	9 / 17 / 19	36
						-94.6		
			67	72		SPT Sampler	3 / 19 / 30	49
						-96.0		
			73	73		SPT Sampler	19 / 19 / 23	42
						-97.6		
		At El. -98.0 Ft., few clay	93	74		SPT Sampler	24 / 21 / 22	43
						-99.0		
			93	75		SPT Sampler	22 / 24 / 19	43
						-100.6		
			93	76		SPT Sampler	18 / 15 / 20	35
						-102.0		
			87	77		SPT Sampler	14 / 16	

(Continued)

SAJ FORM 1836-A
JUN 02

G-6

Boring Designation CP02-EAARS-CB-0002

DRILLING LOG (Cont. Sheet)

INSTALLATION: Jacksonville District

SHEET 7 OF 10 SHEETS

PROJECT: CERP Everglades Agricultural Area Reservoirs

COORDINATE SYSTEM/DATUM: State Plane, FLE | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: X = 736,775 Y = 775,528

ELEVATION TOP OF BORING: 12.0 Ft

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	REC %	BOX OR SAMPLE NO.	ROD NO.	REMARKS	BLOWS/0.5 FT.	N-VALUE
				87	77		-103.6 SPT Sampler	17	33
				87	78		-105.0 SPT Sampler	15 17 14	31
				93	79		-106.6 SPT Sampler	12 10 11	21
				100	80		-108.0 SPT Sampler	13 17 16	33
				93	81		-109.6 SPT Sampler	12 14 18	32
				87	82		-111.0 SPT Sampler	17 22 17	39
				93	83		-112.6 SPT Sampler	12 16 16	32
				73	84		-114.0 SPT Sampler	14 22 19	41
				87	85		-115.6 SPT Sampler	15 14 13	27
				93	86		-117.0 SPT Sampler	14 13 13	26
				73	87		-118.6 SPT Sampler	13 14 10	24
				87	88		-120.0 SPT Sampler	9 10 15	25
				80	89		-121.6 SPT Sampler	26 15 16	31
				87	90		-123.0 SPT Sampler	23 24 18	42

(Continued)

SAJ FORM 1836-A
JUN 02

G-7

Boring Designation CP02-EAARS-CB-0002

DRILLING LOG (Cont. Sheet)

INSTALLATION: Jacksonville District

SHEET 8 OF 10 SHEETS

PROJECT: CERP Everglades Agricultural Area Reservoirs

COORDINATE SYSTEM/DATUM: State Plane, FLE | HORIZONTAL: NAD83 | VERTICAL: NAVD88

LOCATION COORDINATES: X = 736,775 Y = 775,528

ELEVATION TOP OF BORING: 12.0 Ft.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	REC.	BOX OR SAMPLE	ROD CORE	REMARKS	BLOWS/0.5 FT.	N-VALUE
				60	91		SPT Sampler	9 10 11	21
							-124.6		
				93	92		SPT Sampler	17 24 19	43
							-126.0		
				80	93		SPT Sampler	25 28 20	48
							-127.6		
				73	94		SPT Sampler	14 18 19	37
							-129.0		
				87	95		SPT Sampler	12 16 39	55
							-130.6		
-131.0	143.0		SAND, poorly-graded, mostly fine to medium-grained quartz, trace phosphate, light gray (SP)	100	96		SPT Sampler	31 37 24	61
							-132.0		
				100	97		SPT Sampler	17 21 17	38
							-133.6		
				100	98		SPT Sampler	14 16 20	36
							-135.0		
				100	99		SPT Sampler	12 25 27	52
							-136.6		
				100	100		SPT Sampler	12 18 18	36
							-138.0		
				93	101		SPT Sampler	11 16 18	34
							-139.6		
				100	102		SPT Sampler	10 16 22	38
							-141.0		
				67	103		SPT Sampler	15 26 25	51
-142.6	154.5						-142.6		
			Sandstone, fine-grained, some quartz sand.	80	104		SPT Sampler	18	

(Continued)

SAJ FORM 1836-A
JUN 02

G-8

Boring Designation CP02-EAARS-CB-0002

DRILLING LOG (Cont. Sheet)

INSTALLATION	SHEET 9 OF 10 SHEETS
Jacksonville District	

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
CERP Everglades Agricultural Area Reservoirs	State Plane, FLE	NAD83	NAVD88

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 736,775 Y = 775,528	12.0 Ft.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	REC. %	BOX OR SAMPLE	ROD COR	REMARKS	BLOWS/ 0.5 FT.	N VALUE
			few clay, trace shell, trace phosphate, gray						155
			At El. -143.0 Ft., few shell	80	104		SPT Sampler -144.0	20 / 19	39
				93	105		SPT Sampler -145.6	25 / 22 / 24	46
			At El. -145.6 Ft., trace clay	100	106		SPT Sampler -147.0	9 / 17 / 41	58
				73	107		SPT Sampler -148.6	16 / 20 / 20	40
				80	108		SPT Sampler -150.0	15 / 17 / 19	36
				80	109		SPT Sampler -151.6	30 / 20 / 18	38
				73	110		SPT Sampler -153.0	18 / 16 / 21	37
				80	111		SPT Sampler -154.6	14 / 16 / 18	34
				80	112		SPT Sampler -156.0	10 / 18 / 19	37
				73	113		SPT Sampler -157.6	6 / 17 / 14	31
				100	114		SPT Sampler -159.0	14 / 14 / 16	30
-159.0	171.0		SAND, poorly-graded, mostly fine to medium-grained quartz, trace fine gravel-sized sandstone, trace phosphate, light gray (SP)	100	115		SPT Sampler -160.6	15 / 24 / 19	43
-161.0	173.0		Sandstone, medium-grained, some quartz sand, few clay, few shell, trace of phosphate, gray	100	116		SPT Sampler -162.0	14 / 17 / 11	28
				87	117		SPT Sampler	24 / 24	175

(Continued)

SAJ FORM 1836-A
JUN 02

G-9

Boring Designation CP02-EAARS-CB-0002

DRILLING LOG (Cont. Sheet)

INSTALLATION	SHEET
Jacksonville District	10 OF 10 SHEETS

PROJECT	COORDINATE SYSTEM/DATUM	HORIZONTAL	VERTICAL
CERP Everglades Agricultural Area Reservoirs	State Plane, FLE	NAD83	NAVD88

LOCATION COORDINATES	ELEVATION TOP OF BORING
X = 736,775 Y = 775,528	12.0 Ft.

ELEV.	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS	% REC.	BOX OR SAMPLE NO.	ROD CORE NO.	REMARKS	BLOWS/ 0.5 FT.	N-VALUE
				87	117		-163.6 SPT Sampler	18	42
				67	118		SPT Sampler	15 15 18	34
							-165.0		
				100	119		SPT Sampler	17 18 19	37
							-166.6		
				100	120		SPT Sampler	25 26 29	55
-168.0	180.0						-168.0		

NOTES:

1. Soils are field visually classified in accordance with the Unified Soils Classification System.

2. Laboratory Testing Results

SAMPLE ID	SAMPLE DEPTH	LABORATORY CLASSIFICATION
119	177.0/178.5	*

*Lab visual classification based on gradation curve. No Atterberg limits.

3. Additional Laboratory Testing

119 Moisture Content

140# hammer w/30" drop used with 2.0' split spoon (1-3/8" I.D. x 2" O.D.).

Abbreviations:
NR = Not Recorded.
DT = Drill Time.
HP = Hydraulic Pressure.

175
180
185
190
195

SAJ FORM 1836-A
JUN 02

G-10